DOCUMENT RESUME

ED 040 562 EM 007 808

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TITLE	An Analysis of the Experience and Effects of Computer Assisted Scheduling in Selected Institutions of Higher Education.
INSTITUTION	Temple Univ., Philadelphia, Pa. Coll. of Education.
PUB DATE	Jun 69
NOTE	33p.; Document is abstract of a thesis presented to the College of Education, Temple University
AVAILABLE FROM	University Microfilms, 300 N. Zeeb Road, Ann Arbor, Michigan 48106 (TTE-395)
EDRS PRICE	EDRS Price MF-$0.25 HC-$1.75
DESCRIPTORS	*Computer Programs, Data Processing, *Facility Utilization Research, Higher Education, *Scheduling

ABSTRACT

The author used interviews, questionnaires, and in-depth interviews to gather data about the use of computer assisted scheduling systems in operation in higher education. The study presents descriptive data about each system and also seeks to identify those institutions operating superior systems. It compares computer assisted scheduling systems with the previous scheduling system used in each one of the selected institutions studied. (JY)

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FORM 0801

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AN ANALYSIS OF THE EXPERIENCE AND EFFECTS OF COMPUTER ASSISTED SCHEDULING IN SELECTED INSTITUTIONS OF HIGHER EDUCATION

ED040562

An Abstract of a Dissertation

Presented to

the Faculty of the College of Education

Temple University

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

EM 007 808

by

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June, 1969

THE PROBLEM

The purposes of this study were:

1. To identify the different computer assisted scheduling systems in operation in higher education, and to obtain descriptive data about each system.

2. To identify a selected number of institutions of higher education perceived as operating superior computer assisted scheduling systems.

3. To analyze the experiences and effects that these institutions perceived as operating superior systems of computer assisted scheduling have had with their scheduling systems.

4. To compare computer assisted scheduling with the previous scheduling system used in each of the selected institutions studied.

The study of the selected institutions included the reasons which prompted college officials to adopt computer assisted scheduling, the procedures used in introducing computer assisted scheduling, and the problems encountered in the use of computer assisted scheduling.

The study was designed to answer these specific questions:

1. What types of computer assisted scheduling systems were being utilized by institutions of higher education in the United States, and what were some of their cogent characteristics?

2. What prompted college officials to adopt computer assisted scheduling systems?

3. What were the steps followed in introducing computer assisted scheduling?

4. How did the computer assisted scheduling system compare with the previous conventional scheduling system used in each of the selected institutions?

5. What were some of the problems encountered in the use of computer assisted scheduling?

6. What institutions of higher education were perceived, by administrators responsible for scheduling, as operating superior computer scheduling systems?

7. What has been the experience and what were the effects of computer assisted scheduling, as perceived by certain college administrators and key faculty members, in selected institutions of higher education identified as operating superior computer assisted scheduling systems?

DELIMITATIONS

This investigation was confined by the following delimiting factors:

1. This study was limited to two areas of computer assisted scheduling identified as master schedule construction, and student assignment or registration. Such other areas of concern in the scheduling process could only be treated as they directly related to the aforementioned processes.

2. The 132 institutions included in the initial mailing were those identified as scheduling by computer in a survey of electronic data processing applications in institutions of higher education in 1966-67. Twenty-one other institutions were identified by the writer through his personal contacts with registrars, a survey of periodical literature, personal letters to selected institutions and computer manufacturers, and from responses to item fifteen of the questionnaire.

3. Institutions perceived as operating superior computer assisted scheduling systems were limited to those identified by administrative officers responsible for scheduling at the one hundred institutions that participated in this study.

4. A stratified sample of six institutions identified as superior by the survey was used for the in-depth studies.

5. For the institutions selected for in-depth study, the researcher was dependent upon the ability and willingness of the institutional staffs to provide the needed interviews, and when provided, to render them reliable.

6. All data gathered pertained to undergraduate day schools for the 1967-68 college year.

PROCEDURES

The procedures employed in carrying out the study involved three main sources of data.

1. Related literature and research connected with the master schedule construction and registration processes.

2. Institutions of higher education that could be identified as scheduling with computer assistance from:

   a. A 1966-67 survey of the use of electronic data processing equipment conducted by the American Association of Collegiate Registrars and Admissions Officers.

   b. Other institutions identified by the writer through his personal contacts with registrars,

a survey of periodical literature, personal letters to selected institutions and computer manufacturers requesting literature and information, and from responses to item fifteen of the questionnaire.

The initial list of institutions identified as scheduling by computers totaled 153. This list became the basis for the questionnaire survey.

3. Institutions of higher education nominated as operating superior computer assisted scheduling systems by respondents to the questionnaire. A total of thirty-four institutions were nominated in this manner out of which six institutions were selected for further study.

Two major data collection methods were necessary. The first was a questionnaire survey in order to collect data from institutions identified as scheduling with computer assistance.

1. Questionnaire format. A preliminary draft of the questionnaire was developed and arranged into four categories:

a. Classification of the institution. This section included items concerning the type of control, highest degree conferred, enrollment, and other background information.

b. Status of computer assisted scheduling. Information requested in this section pertained to the type of scheduling tasks that were being performed by computers and the dates these computer tasks were initiated.

c. Computer usage. The hardware utilized and the administrative division under which it was placed were items making up this section.

d. Characteristics of the scheduling system. This last section included items related to the planning and introduction of computer assisted scheduling; a rating of scheduling factors when compared with the previous non-computer scheduling system; and items pertaining to problems, change, and future of computer assisted scheduling.

2. Item selection. The items included in this instrument were adapted from four sources:

a. Literature in the field.

b. The researcher's four years of experience with computer assisted scheduling at an institution of higher education.

c. Studies of other researchers.

d. Responses from selected personnel, including the writer's doctoral committee.

3. Pre-testing the instrument.

a. The questionnaire was submitted to persons at two institutions and a service bureau specializing in scheduling who were asked to check the preliminary draft and criticize its make-up and content.

b. The responses obtained from the three groups and members of the writer's doctoral committee were incorporated in the questionnaire.

c. A copy was typed and mailed to six institutions of higher education to discover deficiencies in the instrument. Some minor adjustments were made and the final copy was printed. Verbal responses were sought for the same written items in the questionnaire during interviews conducted at the six institutions. The verbal responses were highly consistent with the written responses except in cases when changes had taken place during the interim.

4. Creating the mailing list.

a. The names of the presidents of each institution to be surveyed were located in a directory of U. S. Institutions of Higher Education published by the Office of Education issued shortly after the beginning of the fall term of 1967.

b. The names of each president, his college, and address were keypunched into data cards. From

these cards printed information was generated for mailing and follow-up purposes.

c. Requests for responses to the questionnaire were sent to the president of each institution to be surveyed. The president, in turn, was asked to forward the questionnaire to the member of his staff most knowledgeable about computer scheduling.

5. Verification of the master mailing list and a request for participation. The first mailing of the questionnaire was sent to all 153 presidents on the initial master list, together with a letter and a postal card.

6. Follow-up procedures.

a. One month after mailing the first questionnaire and postal card, another letter or a postal card and a letter, was sent to those who had not responded or returned the questionnaire. Another questionnaire was included with a requested date for its return again indicated.

b. Approximately one month after the first reminder, another letter or a postal card and letter, was sent to those who either had not returned the questionnaire or had not responded. A sample questionnaire that was completed for Glassboro State College together with another copy of a blank questionnaire was included.

c. Ten long-distance telephone calls were made to ten institutions who had not responded in an effort to further increase the number of responses.

7. Responses to the survey.

a. Seventy-five per cent of the institutions initially surveyed were verified as scheduling with computer assistance.

b. Three per cent of the 153 institutions initially surveyed gave no response.

c. Of the 114 institutions that were verified as scheduling with computer assistance, 105 or 92 per cent agreed to participate in the study.

d. One hundred questionnaires were finally returned. This number represented 88 per cent of the institutions that were verified as scheduling with computer assistance. It also represented 95 per cent of the institutions that had agreed to participate in the study.

The findings of the questionnaire survey, in essence, concern the one hundred institutions of higher education from which the questionnaires were returned.

The second method of data collection involved the use of an interview guide to collect data from individuals

at selected institutions identified as operating superior computer assisted scheduling systems.

1. Item selection. Items for the interview guide were adapted from five sources:

a. Literature and research on computer scheduling reviewed for the study.

b. The researcher's four years of experience with computer assisted scheduling at an institution of higher education.

c. Responses to the initial questionnaire survey.

d. Written information forwarded with the questionnaire from the respondents.

e. Responses from selected personnel, including the writer's doctoral committee.

The items that were developed were quite detailed and were designed for the following purposes:

a. Motivating the respondent in such a way as to insure honest communication.

b. Gaining from the respondent unbiased information and perceptions that would be useful to the study.

c. Presenting to the respondent a series of items that illustrated the depth and purpose of the questions.

d. Allowing the respondent to present his perceptions and feelings about key items in his own style.

2. Pre-testing the interview guide.

a. An analysis was made of the responses to the initial questionnaire. Items were devised to provide further information in areas where additional detail or clarification was desirable.

b. A preliminary draft was submitted to selected college personnel in the researcher's institution and state. The items were modified as deficiencies were noted.

c. A draft of the interview guide was developed and submitted to the three members of the doctoral committee for their suggestions, and then revised according to their recommendations.

d. Another draft of the interview guide was devised, and interviews were held at two institutions of higher education to orient the interviewer and to discover any deficiencies in the instrument.

e. A few deficiencies in the method of presentation and in the interview guide were noted and corrected and the final copy was typed.

3. Preparation for the interviews. In order to obtain a clear perspective of each computer scheduling system to be studied, permission was requested by telephone to interview the following individuals at each of the six institutions:

a. The administrative officer responsible and accountable for scheduling and registration.

b. A data-processing administrator who was familiar with the technical aspects of the computer assisted scheduling system.

c. An academic dean or an assistant knowledgeable about departmental and faculty aspects of scheduling.

d. A department chairman or key faculty member who was both familiar with computer scheduling and knowledgeable about student perceptions concerning the scheduling system.

4. Conducting the interviews.

a. Prior to each interview a personal letter, reiterating the objectives of the interview, was sent to each person contacted.

b. The respondent was given a brief review of the objectives and progress of the study, as well as the objectives of the interview.

c. In each instance, permission was granted from respondents for the researcher to use a tape recorder, thus enabling the interviewer to be free of the mechanics of note taking.

d. General questions were asked first, followed by more specific questions when fruitful areas became obvious.

Findings were treated in two separate categories:

1. Data obtained from the questionnaire survey.

a. All possible responses were converted into code numbers and placed on eighty-column hollerith cards for mechanical sorting according to the size of the institutions and other categories as needed.

b. Where possible, the responses were first placed in a frequency distribution.

c. The percentage of those responding to an item was tabulated. For items that had complete responses and totaled one hundred, the frequency served also to indicate the per cent.

d. The mean was computed for certain data. To analyze the rating of computer assisted scheduling, a "t" test was performed for each factor investigating whether the observed means were significant.

e. The responses for each section of the questionnaire were sub-divided and presented in appropriate tables, figures, and written form where applicable.

2. Data obtained from the in-depth interviews. Written summaries of reported data were made and arranged under the following categories:

a. General information about the type of institution and the reasons it was included in the study.

b. The status and uses of computer assistance in scheduling.

c. The curriculum and implementation strategies used.

d. The reasons for adopting computer assisted scheduling.

e. Investigation and planning for computer assisted scheduling.

f. Perceived effects of computer assisted scheduling for students, faculty, and administrators.

g. Problems encountered in the use of computer assisted scheduling.

h. The future of computer assisted scheduling.

All data as presented were analyzed, thus establighing the areas in which conclusions were drawn and recommendations finally made.

THE FINDINGS OF THE SURVEY

The following findings appeared to be important:

1. Twenty institutions used computers to assist with scheduling prior to 1964. After 1964 a rapid growth in scheduling with computer assistance took place. Eighteen, twenty-one, and twenty-four institutions respectively, initiated computer assisted scheduling in each academic year prior to the study. Eleven institutions initiated computer assisted scheduling during the academic year 1967-68, the year this study was under way.

2. Many types of institutions of higher education have been using computers to assist in scheduling. Public and private community colleges, four-year colleges, and universities--in all enrollment categories--have been using computers for this purpose. No private associate degree granting institution was found using computers for scheduling assistance.

3. Two basic computer assisted scheduling systems were reported by respondents to the questionnaire. The first was a system that mainly performed the section or registration tasks involved in scheduling. The second

type of system performed both registration and timetable assimilation tasks. The extent to which the tasks were tied into an integrated system was varied; some tasks were performed more often than others. Many tasks were in the planning or programming stage and not yet included in a final, complete system.

4. Sixty-nine per cent of the institutions participating in the survey did not base their master schedules (timetables) on a matrix showing students' single and double section course requests. Nineteen per cent of the remaining institutions did base their timetables on a matrix.

5. Fifty of the respondents in the questionnaire study reported that their institutions allowed students to select course sections. Thirty of the forty-eight institutions represented in the enrollment category of 1,000 to 4,999 did not allow students this privilege.

6. In assimilating the master schedule (timetable), the computer was most often used for developing tallies of student course requests. When a matrix was required, the computer was most likely to be used for that task; most other tasks were performed manually.

7. To fulfill registration functions, institutions responding indicated that they used computers most often

to assign students to sections, to create class lists, and to report grades. Unit record equipment or the computer were most often used to help perform the "drop and add" task.

8. Depending on the scheduling task and the computer and program used, actual computer time needed to process five hundred students varied. The median time reported for processing master schedule assimilation tasks was 8.5 minutes per task; for registration, 22.5 minutes per task. Most respondents were not able to supply estimates.

9. About three-fourths of the respondents were not able to estimate the computer costs per student for scheduling tasks. Of those who supplied costs, most indicated that costs per task were under five cents per student per task.

10. Computers from eight different companies were used for scheduling. The IBM Corporation computers performed scheduling tasks in 83 per cent of the institutions in the study. Their series 360 computer was used most often to perform scheduling tasks.

11. Thirty-eight of the one hundred institutions studied reported that more than one computer was available for scheduling. Twenty-nine institutions had a second

computer, seven a third computer, and two a fourth computer available for scheduling.

12. A majority of institutions reported that computers used for scheduling were centrally located on the campus. They were usually placed under a centralized administrative unit or a combined research and administrative unit. Persons responsible for scheduling were usually not responsible for the computer that was used for scheduling.

13. Leadership for the initiation of computer assisted scheduling was usually exerted by the registrar. The director of the computer center or an academic administrator was also likely to exert initiative for using computers to perform scheduling tasks.

14. Sixty-five institutions indicated that either their scheduling programs and/or descriptive literature about the programs were available to other institutions.

15. Besides the registrar, the director of the computer or data center was most often responsible and accountable for computer assisted scheduling.

16. Persons most knowledgeable about computer assisted scheduling, as identified by their chief administrative officer, generally held the master's degree, had about ten years of experience in college work, and held their present positions for six years.

17. The main reason given for using computers to assist in scheduling by institutions was to employ professional time more efficiently. The majority of institutions also used computers to increase student services and to use non-professional time more efficiently.

18. An overwhelming majority of institutions planned for computer assisted scheduling and took at least two steps to insure its success. Fifty-nine per cent of the institutions studied the problems involved in the scheduling process. Almost one-half studied the scheduling systems of other institutions using computers to assist in scheduling.

19. In 68 per cent of the responses, computer assisted scheduling was reported to have had no effect on the instructional program of the institutions. In a little less than one-third of the responses, computer assisted scheduling was reported to have resulted in variable length periods, extra curricular scheduling, and more flexible academic programs for students.

20. Ninety-three per cent of the ninety-two administrators indicating their degree of satisfaction or dissatisfaction with their computer assisted scheduling system perceived themselves as satisfied.

21. Based on a standard test of significance in a rating by administrators of fifteen factors associated with computer assisted scheduling, thirteen factors were perceived as significantly better than the previous system used at the .001 level of significance. The thirteen factors were: (a) use of professional time, (b) use of non-professional time, (c) utilization of facilities, (d) master schedule of classes, (e) student schedules, (f) faculty schedules, (g) satisfaction of administration, (h) changes in student schedules, (i) satisfaction of students, (j) number of conflicts, (k) scheduling errors, (l) utilization of staff, and (m) meeting of educational objectives. The remaining two factors, "total cost per student" and "changes in student schedules," were significant at the .05 level.

22. All respondents except five listed that one or more problems were encountered when introducing computer assisted scheduling. The three major problems cited were:

a. Adequate computer programs were unavailable.

b. Time for planning and introducing the system was inadequate.

c. Personnel familiar with the scheduling process and with the capabilities of the computer were rare.

23. Weaknesses of computer assisted scheduling most often perceived by respondents pertained to the

technical aspects of scheduling, involving hardware and software.

24. Changes in the methods of computer assisted scheduling took place in about one-half of the institutions studied. Hardware and software changes were cited by 69 per cent of the respondents to the query.

25. The most desired improvement in the field of computer assisted scheduling indicated by 37 per cent of those responding to a question, was the development of a good computer assisted master schedule assimilation system. Large institutions tended to desire on-line systems of scheduling tied into a larger university data processing system.

26. A total of thirty-four institutions was nominated as operating superior computer assisted scheduling systems. Purdue University was identified most often. Massachusetts Institute of Technology received the next highest number of nominations.

27. From a total of thirty-four institutions nominated as superior, fourteen institutions indicated that either their computer program or descriptive literature about their program was available for use by other institutions. Eight of the twelve institutions who indicated that materials or the programs were available were nominated by three or more respondents.

GENERALIZATIONS FROM THE IN-DEPTH INTERVIEWS

1. Those interviewed at the institutions in the sample indicated five main objectives for using computers to assist in scheduling. They indicated that they were reaching four of the goals of computer assisted scheduling. The goals reached were:

   a. Better use of professional and non- professional time.

   b. Creation of a better or more flexible timetable to allow students better course and/or section choices.

   c. Improved academic advisement.

   d. An improved registration process.

Although respondents from institutions studied in-depth had as a fifth goal, the lowering of costs, they did not know whether or not the goal was being reached. They had difficulty estimating costs of computer assisted scheduling.

2. At least six steps were taken at institutions studied in-depth when they planned for and investigated computer assisted scheduling. They were:

   a. An identification of the problems associated with scheduling.

b. A determination of the institution's scheduling philosophy.

c. A study of other institutions using computers for scheduling.

d. The development of a program to fit the needs of the institution.

e. A test for the program prior to initiation.

f. A plan to involve and educate all those persons affected during the planning and implementation stages.

3. Administrators and faculty indicated that faculty were little affected by computer assisted scheduling but that they judged it slightly better for them than the previous system used. Primary advantages cited for faculty were:

a. Saving of time.

b. Better balanced classes.

c. Class management materials that were clearer and easier to manipulate.

4. Computer assisted scheduling was perceived by faculty and administrators as better than the previous system for students. Improved effects on students centered around:

a. Improved advisement conditions.

b. Better course choices.

c. Easier and faster registration.

d. Improved schedules.

However, at institutions that operated a "closed" registration system, students desired a chance to select sections of courses.

5. Administrators and faculty at institutions included in the in-depth studies reported that computer assisted scheduling was superior to the previous system of scheduling for administrators. Computer assisted scheduling was adjudged as:

a. Taking less time.

b. Utilizing facilities better.

c. Increasing course flexibility for students.

d. Generating more conflict free schedules easier.

e. Producing management materials easier and superior to those produced by the previous system.

6. Four main problems concerning computer use for scheduling were identified through the in-depth interviews. They were:

a. Problems resulting from hardware and software changes.

b. Interpretation of scheduling philosophy and of needs to data processing personnel.

c. Coordination between the user and data center in implementing the operational scheduling program.

d. Problems of obtaining reactions and decisions from the departments to computer generated information, so that optimum results could be obtained in the implementation of the system.

7. The in-depth interviews revealed that future directions in scheduling should be aimed toward the development of a scheduling system that would be part of a total university data processing system. A movement in favor of the development of systems for faster data collection and for the use of terminal optical scanning devices was noted. Those institutions with closed registration systems saw computer assisted timetable assimilation as a desirable future direction.

CONCLUSIONS

The following conclusions are based on the data collected in the investigation and presented in the study.

1. Although the number of institutions using computers to assist in scheduling has increased since 1964, the yearly number of newly initiated computer assisted scheduling systems appears to have remained at about the same level.

2. Computers can be used to successfully assist in scheduling at institutions of different sizes and types. They can also be used to implement differing scheduling philosophies.

3. Computer assisted scheduling systems are still in the developmental stages at institutions of higher education.

4. The evidence available appears to indicate fairly fast processing and low computer costs per task. Although reducing costs is a goal, few know if they are meeting this goal.

5. Computers of different companies can be utilized by the same institution to assist in scheduling, even though this may not appear to be the most desirable approach.

6. Although the registrar is likely to exert the greatest leadership initiating computer assisted scheduling, it appears that he need not be the controller of the scheduling computer.

7. It appears that computers can be used to aid in creating a more flexible timetable that will allow better student choice of courses and/or sections.

8. It appears that institutions introducing computer assisted scheduling need to include four steps, among others, to help insure success. They are:

a. The determination of the institution's scheduling philosophy.

b. The development of a tailor-made program to fit the specific institution's needs.

c. A test of the program prior to initiation, using actual data.

d. Involvement and education of all those persons affected during the planning and implementation stages.

9. Computer assisted scheduling appears to be perceived by administrators and faculty as better than other systems of scheduling. It appears that computer assisted scheduling produces better results than previous systems for administrators, followed by students and faculty.

10. Student dissatisfaction reported by faculty knowledgeable about student sentiments, appears to center around scheduling philosophy rather than around the computer that was used to implement the philosophy. It appears that the computer often became the scapegoat, however.

11. Computer assisted scheduling has not appeared to negatively affect the instructional program.

12. Institutions planning for computer assisted scheduling can probably anticipate changes and problems connected with changes, in hardware and software. In addition, the following problems may also need to be anticipated:

a. Interpreting scheduling philosophy and needs to data processing personnel, especially programmers.

b. Coordinating the user and the data center in implementing the operational scheduling program.

c. Obtaining reactions and decisions from the departments to computer generated information so that optimum results could be obtained from the system.

13. A need exists for the development of good operational on-line and optical scanning systems for large institutions and of master schedule generators for smaller institutions, especially those with enrollments of fewer than five thousand students.

14. Institutions either planning to adopt computer assisted scheduling or desiring to improve their systems can be aided by many institutions scheduling by computer.

RECOMMENDATIONS

Based on the information gained in the study of computer assisted scheduling in higher education, the following recommendations are made:

1. Institutions desiring to introduce computer assisted scheduling should study, plan, and test the program before implementing the system.

2. The complete use of "canned" programs or programs of other institutions should be avoided. Programs should be developed to meet the unique requirements of each institution, although basic elements from other programs could be modified to fit each situation. This implies the need for acquisition of competent and imaginative programmers and data processing personnel.

3. The institution planning for computer assisted scheduling should take at least the following seven steps to increase its chances of being highly successful:

a. An identification of the problems associated with scheduling.

b. A determination of the institution's scheduling philosophy and goals.

c. A study of the institutions operating superior computer assisted scheduling systems, using different philosophies.

d. A development of a program to fit the needs of the institution.

e. A test of the program several times prior to its inauguration, using actual data.

f. The involvement and education of all those persons affected by the system, during the planning and implementation stages.

g. An evaluation of the system according to the established goals using students, faculty, and administrators.

4. Administrators in higher education with ultimate and immediate responsibility for scheduling, should become familiar with institutional computer applications in general, as well as with the application cf computers

to assist in scheduling. This is desirable to enable them to communicate their needs to data processing personnel, as well as to individuals with other administrative responsibilities, who are part of a broader data processing system.

5. Administrators, especially those who are unable to adequately familiarize themselves with computer applications in higher education, would do well to obtain a qualified consultant from an institution that has developed a superior administrative computer system. When dealing with the scheduling aspect of the system, administrators should bring in a qualified person for consultation from an institution that has developed a superior scheduling system.

6. Some types of short-term workshops in computer assisted scheduling should be instituted for administrators responsible for scheduling by those institutions that operate superior computer assisted scheduling systems. There appears to be a need for this type of leadership.

7. For groups of institutions in a specified geographical area who do not own computers, the feasibility of a consortium should be explored. The consortium could allow the acquisition of a computer large enough to perform

many administrative applications, one of which could be computer assisted scheduling.

8. In developing a university-wide data system, the registrar and the director of the computer center or any other person who might happen to have responsibilities in scheduling should be involved.

9. A study should be undertaken in an attempt to clearly determine the time and costs involved in using computers to assist in scheduling.

10. A study of institutions using service bureaus or renting computer time should be undertaken in order to determine the feasibility of using these approaches to scheduling by computer.

11. Additional research concerning the effects of computer assisted scheduling on students should be undertaken. The study should include direct student opinion sampling.